

IT IS CLAIMED

1. A method for implementing redundancy of stateful network address translation information in at least one network device of a data network, the method comprising:

5 receiving, at a first network device, a first packet from a source device, said first packet including a header portion comprising address information relating to a source device and a destination device associated with the first packet;

generating a first network address translation (NAT) entry relating to the source device of the first packet, wherein the source device is associated with a globally unique  
10 network address;

storing the first NAT entry in a first NAT data structure residing at the first network device;

generating a first network address translation (NAT) transaction message which includes information relating to updates or modifications performed on the first NAT data  
15 structure; and

transmitting the first NAT transaction message to at least one other network device to thereby cause the at least one other network device to update a respective NAT data structure associated with the at least one other network device using information from said first NAT transaction message.  
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2. The method of claim 1 wherein the first NAT entry includes a NAT ID field relating to an identity of a specific network device which is responsible for controlling modification of that particular NAT entry.

25 3. The method of claim 2 further comprising consulting the NAT ID field corresponding to a particular NAT entry in the first NAT data structure to determine whether modification of the particular NAT entry may be performed.

30 4. The method of claim 3 further comprising allowing the first network device to modify the particular NAT entry in response to a determination that the NAT ID field of the particular NAT entry corresponds to said first network device.

5. The method of claim 3 further comprising preventing the first network device from modifying the particular NAT entry in response to a determination that the NAT ID field of the particular NAT entry does not correspond to said first network device.

6. The method of claim 2 wherein the NAT transaction message comprises information relating to:

an identifier of the at least one other network device; and

instructions for causing the at least one other network device to modify its respective NAT data structure to include a NAT entry comprising information that is substantially identical to the information contained in the first NAT entry.

7. The method of claim 1 wherein the first network device is a router.

8. The method of claim 6 further comprising:

receiving said first NAT transaction message at the at least one other network device; and

modifying a second NAT data structure residing on the at least one other network device in accordance with instructions provided in said first NAT transaction message.

9. The method of claim 8 wherein said modifying includes creating a new NAT entry in the second data structure comprising information that is substantially identical to the information contained in said first NAT entry.

10. The method of claim 1 wherein the first network device is configured as a primary traffic handling device of a primary-backup redundancy group, and wherein the at least one other network device is configured as a backup traffic handling device of the primary-backup redundancy group.

11. The method of claim 1 wherein the first network device is configured as an active traffic handling device of an active-standby redundancy group, and wherein the at

least one other network device is configured as a standby traffic handling device of the active-standby redundancy group.

12. The method of claim 1 wherein the first network device is configured as an first peer traffic handling device of a peer-peer redundancy group, and wherein the at least one other network device is configured as a second peer traffic handling device of the peer-peer redundancy group.

13. A method for synchronizing network address translation (NAT) information stored on different network devices that have been configured to implement a network address translation protocol, each of said network devices including a respective NAT data structure configured to store said NAT information, the method comprising:

creating, in a first NAT data structure of a first network device, a first network address translation (NAT) entry relating to a network node engaged in a communication session, said first NAT entry including information relating to a local network address of the network node and a dynamically assigned global network address of the network node;

generating a first network address translation (NAT) transaction message which includes information relating to updates or modifications performed on the first NAT data structure; and

transmitting the first NAT transaction message to at least one other network device to thereby cause the at least one other network device to update a respective NAT data structure associated with the at least one other network device using information from said first NAT transaction message.

14. The method of claim 13 wherein the first NAT entry includes a NAT ID field relating to an identity of a specific network device which is responsible for controlling modification of the first NAT entry.

15. The method of claim 14 wherein the NAT transaction message comprises information relating to:

an identifier of the at least one other network device; and

instructions for causing the at least one other network device to modify its respective NAT data structure by creating a second NAT entry comprising information that is substantially identical to the information included in the first NAT entry.

5           16.    The method of claim 15 wherein the second NAT entry includes a corresponding NAT ID field which specifies an identity of the first network device.

17.    The method of claim 15 further comprising:  
receiving said first NAT transaction message at the at least one other network  
10 device; and  
modifying a second NAT data structure residing on the at least one other network device in accordance with instructions provided in said first NAT transaction message.

18.    The method of claim 17 wherein said modifying includes creating a new  
15 NAT entry in the second data structure comprising information that is substantially identical to the information contained in said first NAT entry.

19.    The method of claim 15 further comprising:  
receiving said first NAT transaction message at the at least one other network  
20 device; and  
modifying, using information from said first NAT transaction message, a second NAT data structure residing on the at least one other network device by creating a second NAT entry in the second data structure, said second NAT entry comprising information that is substantially identical to the information included in said first NAT entry.

25           20.    The method of claim 19 further comprising consulting a NAT ID field corresponding to a particular NAT entry in the second NAT data structure to determine whether modification of the particular NAT entry may be performed.

30           21.    The method of claim 20 further comprising allowing the at least one other network device to modify the particular NAT entry in response to a determination that the

NAT ID field of the particular NAT entry corresponds to said at least one other network device.

22. The method of claim 20 further comprising preventing the at least one other network device from modifying the particular NAT entry in response to a determination that the NAT ID field of the particular NAT entry does not correspond to said at least one other network device.

23. The method of claim 13 wherein the first network device is configured as a primary traffic handling device of a primary-backup redundancy group, and wherein the at least one other network device is configured as a backup traffic handling device of the primary-backup redundancy group.

24. The method of claim 13 wherein the first network device is configured as an active traffic handling device of an active-standby redundancy group, and wherein the at least one other network device is configured as a standby traffic handling device of the active-standby redundancy group.

25. The method of claim 13 wherein the first network device is configured as an first peer traffic handling device of a peer-peer redundancy group, and wherein the at least one other network device is configured as a second peer traffic handling device of the peer-peer redundancy group.

26. A method for synchronizing network address translation (NAT) information stored on different network devices that have been configured to implement a network address translation protocol, each of said network devices including a respective NAT data structure configured to store said NAT information, said NAT information including at least one NAT entry relating to a network node engaged in a communication session with at least one other network node, the method comprising:

modifying at least one NAT entry in a first NAT data structure associated with a first NAT network device;

generating a first network address translation (NAT) transaction message which includes information relating the modifications performed on the first NAT data structure; and

transmitting the first NAT transaction message to at least one other NAT network device to thereby cause the at least one other NAT network device to modify a respective NAT data structure associated with the at least one other NAT network device using information from said first NAT transaction message.

27. The method of claim 26 wherein the NAT transaction message includes information relating to an addition of a new NAT entry to the first NAT data structure.

28. The method of claim 26 wherein the NAT transaction message includes information relating to a deletion of a NAT entry from the first NAT data structure.

29. The method of claim 26 wherein the NAT transaction message includes information relating to a modification of an existing NAT entry in the first NAT data structure.

30. A computer program product comprising a computer readable medium, the computer readable medium comprising computer code for implementing the method of claim 26.

31. A method for synchronizing network address translation (NAT) information stored on different network devices that have been configured to implement a network address translation protocol, each of said network devices including a respective NAT data structure configured to store said NAT information, the method comprising:

receiving, at a first network device, a first NAT transaction message which includes updated network address translation (NAT) information generated by a second network device, the updated NAT information including information relating to modifications to be performed on NAT information stored in a first NAT data structure on the first network device; and

modifying the first NAT data structure using information from said first NAT transaction message to thereby achieve synchronization of NAT information stored on the first and second network devices.

5           32.     The method of claim 31 wherein the NAT transaction message includes instructions to add a new NAT entry to the first NAT data structure.

          33.     The method of claim 31 wherein the NAT transaction message includes instructions to delete a specific NAT entry stored in the first NAT data structure.

10           34.     The method of claim 31 wherein the NAT transaction message includes instructions to modify an existing NAT entry in the first NAT data structure.

15           35.     A network device configured to implement redundancy of stateful network address translation information in a data network, the network device comprising:

          at least one processor;

          at least one interface configured or designed to provide a communication link to at least one other network device in the data network; and

          memory;

20           said at least one processor being configured to store in said memory a plurality of data structures, including:

          a first network address translation (NAT) data structure configured to store information relating to address translations corresponding to selected network nodes in the network; and

25           a NAT transaction data structure configured to store transactional information relating to updates or modifications performed on the first NAT data structure;

          said network device being configured to transmit at least a portion of said NAT transactional information to said at least one other network device to thereby cause the at least one other NAT network device to modify a respective NAT data structure associated  
30           with the at least one other NAT network device using the NAT transaction information.

          36.     The device of claim 35:

wherein the network device is further configured or designed to receive NAT transactional information from said at least one other device, said received NAT transactional information including information relating to updates or modifications performed on said respective NAT data structure associated with the at least one other network device; and

wherein the network device is further configured or designed to update or modify said first NAT data structure using data from said received NAT transactional information to thereby achieve redundancy of NAT information stored on the first network device and the at least one other network device.

37. The device of claim 35 wherein the network device is configured as a primary traffic handling device of a primary-backup redundancy group, and wherein the at least one other network device is configured as a backup traffic handling device of the primary-backup redundancy group.

38. The device of claim 35 wherein the network device is configured as an active traffic handling device of an active-standby redundancy group, and wherein the at least one other network device is configured as a standby traffic handling device of the active-standby redundancy group.

39. The device of claim 36 wherein the network device is configured as a first peer traffic handling device of a peer-peer redundancy group, and wherein the at least one other network device is configured as a second peer traffic handling device of the peer-peer redundancy group.

40. The device of claim 36 wherein the network device is configured as a traffic handling device and further comprises a routing table.

41. A network device configured to implement redundancy of stateful network address translation information in a data network, the network device comprising:  
at least one processor;



at least one interface configured or designed to provide a communication link to second network device in the data network; and

memory;

said at least one processor being configured to store in said memory a plurality of

5 data structures, including:

a first network address translation (NAT) data structure configured to store information relating to address translations corresponding to selected network nodes in the network; and

10 a NAT transaction data structure configured to store transactional information relating to updates or modifications performed on the first NAT data structure;

wherein the network device is configured or designed to receive NAT transactional information from said a second network device, said received NAT transactional information including information relating to updates or modifications of NAT information associated with a second NAT data structure corresponding to the second network device; and

15 wherein the network device is further configured or designed to update or modify said first NAT data structure using data from said received NAT transactional information to thereby achieve redundancy of NAT information stored on the first and second network devices.

20 42. A system for synchronizing network address translation information stored on different network devices in a data network, the system comprising:

a first network device configured to implement a network address translation protocol, the first network device comprising:

25 at least one first processor; and

first memory;

wherein said at least one first processor is configured to store in said first memory a first plurality of data structures, including:

30 a first network address translation (NAT) data structure configured to store information relating to address translations corresponding to selected network nodes in the network; and

a first NAT transaction data structure configured to store transactional information relating to updates or modifications performed on the first NAT data structure;

said first network device being configured to transmit at least a portion of said NAT transactional information to at least one other network device; and

5 a second network device configured to implement a network address translation protocol, the second network device comprising:

at least one second processor; and

second memory;

10 wherein said at least one first processor is configured to store in said second memory a second plurality of data structures, including:

a second network address translation (NAT) data structure configured to store information relating to address translations corresponding to selected network nodes in the network; and

15 a second NAT transaction data structure configured to store transactional information relating to updates or modifications performed on the second NAT data structure;

20 said second network device being configured or designed to receive NAT transactional information from said first device, and update or modify said second NAT data structure using data from the NAT transactional information received from the first device.

25 43. The device of claim 42 wherein the first network device is configured as a primary traffic handling device of a primary-backup redundancy group, and wherein the second network device is configured as a backup traffic handling device of the primary-backup redundancy group.

30 44. The device of claim 42 wherein the first network device is configured as an active traffic handling device of an active-standby redundancy group, and wherein the second network device is configured as a standby traffic handling device of the active-standby redundancy group.

45. The device of claim 42 wherein the first network device is configured as a first peer traffic handling device of a peer-peer redundancy group, and wherein the second network device is configured as a second peer traffic handling device of the peer-peer redundancy group.

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46. A computer program product for synchronizing network address translation (NAT) information stored on different network devices that have been configured to implement a network address translation protocol, each of said network devices including a respective NAT data structure configured to store said NAT information, the computer  
10 program product comprising:

a comprising a computer readable medium, the computer readable medium comprising:

computer code for creating, in a first NAT data structure of a first network device, a first network address translation (NAT) entry relating to a network node engaged in a  
15 communication session, said first NAT entry including information relating to a local network address of the network node and a dynamically assigned global network address of the network node;

computer code for generating a first network address translation (NAT) transaction message which includes information relating to updates or modifications performed on the  
20 first NAT data structure; and

computer code for transmitting the first NAT transaction message to at least one other network device to thereby cause the at least one other network device to update a respective NAT data structure associated with the at least one other network device using  
25 information from said first NAT transaction message.

47. The computer program product of claim 46 further comprising:  
computer code for receiving a second NAT transaction message from the at least one other network device; and  
computer code for modifying the first NAT data structure in accordance with  
30 instructions provided in said second NAT transaction message.

48. A computer program product for synchronizing network address translation (NAT) information stored on different network devices that have been configured to implement a network address translation protocol, each of said network devices including a respective NAT data structure configured to store said NAT information, the computer  
5 program product comprising:

a comprising a computer readable medium, the computer readable medium comprising:

computer code for receiving, at a first network device, a first NAT transaction message which includes updated network address translation (NAT) information generated  
10 by a second network device, the updated NAT information including information relating to modifications to be performed on NAT information stored in a first NAT data structure on the first network device; and

computer code for modifying the first NAT data structure using information from said first NAT transaction message to thereby achieve synchronization of NAT  
15 information stored on the first and second network devices.

49. A network device configured to implement redundancy of stateful network address translation information in a data network, the network device comprising:

means for creating, in a first NAT data structure of a first network device, a first  
20 network address translation (NAT) entry relating to a network node engaged in a communication session, said first NAT entry including information relating to a local network address of the network node and a dynamically assigned global network address of the network node;

means for generating a first network address translation (NAT) transaction message  
25 which includes information relating to updates or modifications performed on the first NAT data structure; and

means for transmitting the first NAT transaction message to at least one other network device to thereby cause the at least one other network device to update a respective NAT data structure associated with the at least one network device using  
30 information from said first NAT transaction message.

50. A network device configured to implement redundancy of stateful network address translation information in a data network, the network device comprising:

means for receiving, at a first network device, a first NAT transaction message which includes updated network address translation (NAT) information generated by a second network device, the updated NAT information corresponding to updated NAT information stored on the second network device, the updated NAT information including information relating to modifications to be performed on NAT information stored in a first NAT data structure on the first network device; and

modifying the first NAT data structure using information from said first NAT transaction message to thereby achieve redundancy of NAT information stored on the first and second network devices.